



SHORTCUT ON TIME, SPEED AND DISTANCE

This Chapter is taken from our Book:



Shortcuts in
Quantitative Aptitude
for Competitive Exams

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Time, Speed and Distance

EXAMPLE 1. The driver of a maruti car driving at the speed of 68 km/h locates a bus 40 metres ahead of him travelling in the same direction. After 10 seconds, the bus is 60 metres behind. The speed of the bus is.

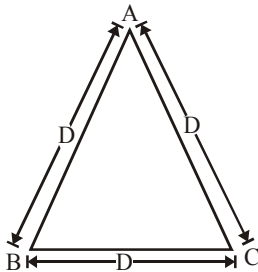
Sol. Let speed of Bus = S_B km/h.
Now, in 10 sec., car covers the relative distance
 $= (60 + 40) \text{ m} = 100 \text{ m}$
 \therefore Relative speed of car = $\frac{100}{10} = 10 \text{ m/s}$
 $= 10 \times \frac{18}{5} = 36 \text{ km/h}$

$$\therefore 68 - S_B = 36$$

$$\Rightarrow S_B = 32 \text{ km/h}$$

EXAMPLE 2. If a person goes around an equilateral triangle shaped field at speed of 10, 20 and 40 kmph on the first, second and third side respectively and reaches back to the starting point, then find his average speed during the journey.

Sol. Let the measure of each side of triangle is D km. The person travelled the distance from A to B with 10 kmph, B to C with 20 kmph and C to A with 40 kmph.



If T_{AB} = Time taken by the person to travel from A to B,
 T_{BC} = Time taken by the person to travel from B to C and
 T_{CA} = Time taken by the person to travel from C to A.
 Then total time = $T_{AB} + T_{BC} + T_{CA}$

$$= \frac{D}{10} + \frac{D}{20} + \frac{D}{40} = D \left(\frac{8+4+2}{80} \right) = \frac{7D}{40}$$

Total distance travelled = $D + D + D = 3D$
 Hence, average speed

$$= \frac{3D}{\frac{7D}{40}} = \frac{120}{7} = 17\frac{1}{7} \text{ kmph.}$$

EXAMPLE 3. Two guns were fired from the same place at an interval of 15 min, but a person in a bus approaching the place hears the second report 14 min 30 sec after the first. Find the speed of the bus, supposing that sound travels 330 m per sec.

Sol. Distance travelled by the bus in 14 min 30 sec could be travelled by sound in $(15 \text{ min} - 14 \text{ min } 30 \text{ sec}) = 30$ second.

$$\therefore \text{Bus travels } 330 \times 30 \text{ m in } 14\frac{1}{2} \text{ min.}$$

$$\therefore \text{Speed of the bus per hour}$$

$$= \frac{330 \times 30 \times 2 \times 60}{29 \times 1000} = \frac{99 \times 12}{29} = \frac{1188}{29} = 40\frac{28}{29} \text{ km/hr}$$

EXAMPLE 4. A hare sees a dog 100 m away from her and scuds off in the opposite direction at a speed of 12 km/h. A minute later the dog perceives her and gives chase at a speed of 16 km/h. How soon will the dog overtake the hare and at what distance from the spot where the hare took flight?

Sol. Suppose the hare at H sees the dog at D.



$\therefore DH = 100 \text{ m}$
 Let K be the position of the hare where the dog sees her.
 $\therefore HK$ = the distance gone by the hare in 1 min

$$= \frac{12 \times 1000}{60} \times 1 \text{ m} = 200 \text{ m}$$

$\therefore DK = 100 + 200 = 300 \text{ m}$
 The hare thus has a start of 300 m.
 Now the dog gains $(16 - 12)$ or 4 km/h.

$$\therefore \text{The dog will gain 300 m in } \frac{60 \times 300}{4 \times 1000} \text{ min or } 4\frac{1}{2} \text{ min.}$$

Again, the distance gone by the hare in $4\frac{1}{2} \text{ min}$

$$= \frac{12 \times 1000}{60} \times 4\frac{1}{2} = 900 \text{ m}$$

\therefore Distance of the place where the hare is caught from the spot H where the hare took flight = $200 + 900 = 1100 \text{ m}$

EXAMPLE 5. A train starts from A to B and another from B to A at the same time. After crossing each other they complete their journey in $3\frac{1}{2}$ and $2\frac{4}{7}$ hours respectively. If the speed of the first is 60 km/h, then find the speed of the second train.
Sol.

$$\frac{\text{1st train's speed}}{\text{2nd train's speed}} = \sqrt{\frac{y}{x}} = \sqrt{\frac{2\frac{4}{7}}{3\frac{1}{2}}} = \sqrt{\frac{18 \times \frac{2}{7}}{7}} = \frac{6}{7}$$

$$\therefore \frac{60}{\text{2nd train's speed}} = \frac{6}{7}$$

$$\Rightarrow \text{2nd train's speed} = 70 \text{ km/h.}$$

EXAMPLE 6. A boy walking at $\frac{3}{5}$ of his usual speed, reaches his school 14 min late. Find his usual time to reach the school.

Sol. Usual time = $\frac{14}{\frac{5}{3}-1} = \frac{14 \times 3}{2} = 21 \text{ min}$

EXAMPLE 7. A train after travelling 50 km, meets with an accident and then proceeds at $\frac{4}{5}$ of its former rate and arrives at the terminal 45 minutes late. Had the accident happened 20 km further on, it would have arrived 12 minutes sooner. Find the speed of the train and the distance.

Sol. Let A be the starting place, B the terminal, C and D the places where the accidents to be placed.



By travelling at $\frac{4}{5}$ of its original rate the train would take $\frac{5}{4}$

of its usual time, i.e., $\frac{1}{4}$ of its original time more.

$\therefore \frac{1}{4}$ of the usual time taken to travel the distance
CB = 45 min. ... (i)

and $\frac{1}{4}$ of the usual time taken to travel the distance

DB = (45 - 12) min ... (ii)

Subtracting (ii) from (i),

$\frac{1}{4}$ of the usual time taken to travel the distance

CD = 12 min.

\therefore Usual time taken on travel 20 km = 48 min.

\therefore Speed of the train per hour = $\frac{20}{48} \times 60$ or 25 km/h.

From (i), we have

Time taken to travel CB = 45×4 min = 3 hrs.

\therefore The distance CB = 25×3 or 75 km.

Hence the distance AB = the distance (AC + CB)
= 50 + 75 or 125 km.

EXAMPLE 8. A man covers a certain distance on scooter. Had he moved 3 km/h faster, he would have taken 20 min less. If he had moved 2 km/h slower, he would have taken 20 min more. Find the original speed.

Sol. Speed = $\frac{2 \times (3 \times 2)}{3 - 2} = 12$ km/hr.

EXAMPLE 9. A boy walking at a speed of 10 km/h reaches his school 12 min late. Next time at a speed of 15 km/h reaches his school 7 min late. Find the distance of his school from his house?

Sol. Difference between the time = $12 - 7 = 5$ min = $\frac{5}{60} = \frac{1}{12}$ hr

Required distance = $\frac{15 \times 10}{15 - 10} \times \frac{1}{12} = \frac{150}{5} \times \frac{1}{12} = 2.5$ km

EXAMPLE 10. A bus leaves Ludhiana at 5 am and reaches Delhi at 12 noon. Another bus leaves Delhi at 8 am and reaches Ludhiana at 3 pm. At what time do the buses meet?

Sol. Converting all the times into 24 hour clock time, we get 5 am = 500, 12 noon = 1200, 8 am = 800 and 3 pm = 1500

Required time = $500 + \frac{(1200 - 500)(1500 - 500)}{(1200 - 500) + (1500 - 800)}$

= $500 + \frac{700 \times 1000}{700 + 700} = 1000 = 10$ am.

EXAMPLE 11. A man takes 6 hours 30 min. in going by a cycle and coming back by scooter. He would have lost 2 hours 10 min by going on cycle both ways. How long would it take him to go by scooter both ways?

Sol. Clearly, time taken by him to go by scooter both way

$$= 6\text{h.}30\text{m} - 2\text{h.}10\text{m} = 4\text{h.}20\text{m} = 4\frac{1}{3}\text{h}$$

EXAMPLE 12. A man travels 120 km by ship, 450 km by rail and 60 km by horse taking altogether 13 hrs 30 min. The speed of the train is 3 times that of the horse and $1\frac{1}{2}$ times that of the ship. Find the speed of the train.

Sol. If the speed of the horse is x km/hr; that of the train is 3x and

that of the ship is $\frac{3x}{1\frac{1}{2}} = 2x$ km/hr

$$\therefore \frac{120}{2x} + \frac{450}{3x} + \frac{60}{x} = \frac{27}{2}$$

$$\therefore \frac{60}{x} + \frac{150}{x} + \frac{60}{x} = \frac{27}{2} \quad \therefore \frac{270}{x} = \frac{27}{2}$$

$$\therefore x = 20 \quad \therefore \text{Speed of the train} = 60 \text{ km/hr.}$$

EXAMPLE 13. Rajesh travelled from the city A to city B covering as much distance in the second part as he did in the first part of his journey. His speed during the second part was twice his speed during the first part of the journey. What is his average speed of journey during the entire travel?

(1) His average speed is the harmonic mean of the individual speed for the two parts.

(2) His average speed is the arithmetic mean of the individual speed for the two parts.

(3) His average speed is the geometric mean of the individual speeds for the two parts.

(4) Cannot be determined.

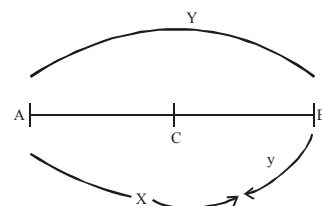
Sol. (1) The first part is $\frac{1}{2}$ of the total distance & the second part is $\frac{1}{2}$ of the total distance. Suppose, he travels at a km/hr speed during the first half & b km/hr speed during the second half. When distance travelled is the same in both parts of

the journey, the average speed is gives by the formula $\frac{2ab}{a+b}$
i.e. the harmonic mean of the two speeds.

EXAMPLE 14. Two friends X and Y walk from A to B at a

distance of 39 km, at 3 km an hour and $3\frac{1}{2}$ km an hour respectively. Y reaches B, returns immediately and meet x at C. Find the distance from A to C.

Sol. When Y meets X at C, Y has walked the distance AB + BC and X has walked the distance AC.



So, both X and Y have walked together a distance

$$= 2 \times AB = 2 \times 39 = 78 \text{ km}.$$

The ratio of the speeds of X and Y is $3 : 3\frac{1}{2}$ i.e., $\frac{6}{7}$

Hence, the distance travelled by X = AC

$$= \frac{6}{6+7} \times 78 = 36 \text{ km}$$

EXAMPLE 15. A man rides one-third of the distance from A to B at the rate of 'a' kmph and the remaining at the rate of '2b' kmph. If he had travelled at the uniform rate of 3c kmph, he could have rode from A to B and back again in the same time. Find a relationship between a, b and c.

Sol. Let the distance between A and B is X km and T_1 and T_2 be the time taken, then

$$T_1 = \frac{X}{3a}, \quad T_2 = \frac{2X}{6b} = \frac{X}{3b}, \quad T_1 + T_2 = \frac{X}{3} \left[\frac{a+b}{ab} \right]$$

Let T_3 be the time taken in third case, then $T_3 = \frac{2X}{3c}$

$$\Rightarrow \frac{2X}{3c} = \frac{X}{3ab} (a+b) \Rightarrow \frac{2}{c} = \frac{a+b}{ab} \Rightarrow c = \frac{2ab}{a+b}$$

EXAMPLE 16. Two cyclists start from the same place to ride in the same direction. A starts at noon at 8 kmph and B at 1.30 pm at 10 kmph. How far will A have ridden before he is overtaken by B? Find also at what times A and B will be 5 km apart.

Sol. If A rides for X hours before he is overtaken, then B rides for (X - 1.5) hrs.

$$\Rightarrow 8X = 10(X - 1.5) \Rightarrow X = 7.5$$

$$\Rightarrow \text{A will have ridden } 8 \times 7.5 \text{ km or } 60 \text{ km}.$$

For the second part, if Y = the required number of hours after noon, then

$$8X = 10(X - 1.5) \pm 5$$

$$\Rightarrow X = 10 \text{ or } 5 \text{ according as B is ahead or behind A.}$$

$$\Rightarrow \text{The required times are 5 p.m. and 10 p.m.}$$

EXAMPLE 17. Two men A and B start from a place P walking at 3 kmph and $3\frac{1}{2}$ kmph respectively. How many km apart will they be at the end of $2\frac{1}{2}$ hours?

(i) If they walk in opposite directions?

(ii) If they walk in the same direction?

(iii) What time will they take to be 16 km apart if.

(a) they walk in opposite directions?

(b) in the same direction?

Sol. (i) When they walk in opposite directions, they will be

$$\left(3 + 3\frac{1}{2} \right) = 6\frac{1}{2} \text{ km apart in 1 hour.}$$

$$\therefore \text{In } 2\frac{1}{2} \text{ hours they will be } 6\frac{1}{2} \times \frac{5}{2} = 16\frac{1}{4} \text{ km apart.}$$

(ii) If they walk in the same direction, they will be

$$3\frac{1}{2} - 3 = \frac{1}{2} \text{ km apart in 1 hour.}$$

$$\Rightarrow \text{In } 2\frac{1}{2} \text{ hours they will be } \frac{1}{2} \times \frac{5}{2} = 1\frac{1}{4} \text{ km apart.}$$

(iii) Time to be 16 km apart while walking in opposite

$$\text{directions} = \frac{16}{3 + 3\frac{1}{2}} = 2\frac{6}{13} \text{ hours.}$$

But if they walk in the same direction,

$$\text{time} = \frac{16}{3\frac{1}{2} - 3} = 32 \text{ hours}$$

EXAMPLE 18. How long does a train 90 m long running at the rate of 54 km/h take to cross –

- a Mahatma Gandhi's statue?
- a platform 120 m long?
- another train 150 m long, standing on another parallel track?
- another train 160 m long running at 36 km/h in same direction?
- another train 160 m long running at 36 km/h in opposite direction?
- a man running at 6 km/h in same direction?
- a man running at 6 km/h in opposite direction?

Sol. (a) The statue is a stationary object, so time taken by train is same as time taken by train to cover a distance equal to its own length.

$$\text{Now, } 54 \text{ km/h} = 54 \times \frac{5}{18} = 15 \text{ m/s}$$

$$\therefore \text{Required time} = \frac{90}{15} = 6 \text{ sec.}$$

(b) The platform is stationary of length = 120 m.

Length to be covered

$$= \text{Length of the train} + \text{Length of the platform}$$

$$= 90 + 120 = 210 \text{ m}$$

$$\therefore \text{Required time} = \frac{210}{15} = 14 \text{ sec.}$$

(c) Length to be covered

$$= \text{Length of the train} + \text{length of the other train}$$

$$= 90 + 150 = 240 \text{ m.}$$

$$\therefore \text{Required time} = \frac{240}{15} = 16 \text{ sec.}$$

(d) Another train is moving in same direction.

Length to be covered

$$= \text{Length of the train} + \text{length of the other train}$$

$$= 90 + 160 = 250 \text{ m}$$

$$\text{Relative speed} = 54 - 36 = 18 \text{ kmph.}$$

$$\therefore \text{Required time} = \frac{250}{18 \times \frac{5}{18}} = 50 \text{ sec.}$$

(e) Another train is moving in opposite direction.

Length to be covered

$$= \text{Length of the train} + \text{length of the other train}$$

$$= 90 + 160 = 250 \text{ m}$$

$$\text{Relative speed} = 54 + 36 = 90 \text{ kmph}$$

$$\therefore \text{Required speed} = \frac{250}{\frac{5}{18} \times 90} = 10 \text{ sec.}$$

(f) The man is moving in same direction,

so Length to be covered = Length of the train,

and relative speed = speed of train – speed of man

$$\therefore \text{Required time} = \frac{90}{(54-6) \times \frac{5}{18}} \\ = \frac{90}{40} \times 3 = \frac{27}{4} = 6\frac{3}{4} \text{ sec.}$$

- (g) The man is moving in opposite direction, so
Length to be covered = Length of the train, and
relative speed = speed of train + speed of man

$$\therefore \text{Required time} = \frac{90}{(54+6) \times \frac{5}{18}} = \frac{27}{5} = 5\frac{2}{5} \text{ sec.}$$

EXAMPLE 19. Two trains of equal lengths are running on parallel tracks in the same direction at 46 km/h and 36 km/h, respectively. The faster train passes the slower train in 36 sec. The length of each train is :

- (a) 50 m (b) 80 m
(c) 72 m (d) 82 m
(e) None of these

Sol. (a) Let the length of each train be x metres.

Then, the total distance covered = $(x + x) = 2x$ m

$$\text{Relative speed} = (46 - 36) = 10 \text{ km/h} = \frac{10 \times 5}{18} \text{ m/s}$$

$$\text{Now, } 36 = \frac{2x \times 18}{50} \text{ or } x = 50 \text{ m}$$

EXAMPLE 20. A train 110 m in length travels at 60 km/h. How much time does the train take in passing a man walking at 6 km/h against the train ?

- (a) 6 s (b) 12 s
(c) 10 s (d) 18 s
(e) None of these

Sol. (a) Relative speeds of the train and the man

$$= (60 + 6) = 66 \text{ km/h} = \frac{66 \times 5}{18} \text{ m/s}$$

Distance = 110 m

Therefore, time taken in passing the men

$$= \frac{110 \times 18}{66 \times 5} = 6 \text{ s}$$

EXAMPLE 21. Two trains 137 metres and 163 metres in length are running towards each other on parallel lines, one at the rate of 42 kmph and another at 48 kmph. In what time will they be clear of each other from the moment they meet?

- (a) 10 sec (b) 12 sec
(c) 14 sec (d) cannot be determined
(e) None of these

Sol. (b) Relative speed of the trains

$$= (42 + 48) \text{ kmph} = 90 \text{ kmph}$$

$$= \left(90 \times \frac{5}{18} \right) \text{ m/sec} = 25 \text{ m/sec.}$$

Time taken by the trains to pass each other

$$= \text{Time taken to cover } (137 + 163) \text{ m at } 25 \text{ m/sec}$$

$$= \left(\frac{300}{25} \right) \text{ sec} = 12 \text{ seconds.}$$

EXAMPLE 22. A train of length 250m, passes a platform of 350 m length in 50s. What time will this train take to pass the platform of 230m length.

Sol. Here, $L = 250$ m, $x = 350$ m, $t_1 = 50$ s,
 $y = 230$ m and $t_2 = ?$

$$\therefore t_2 = \left(\frac{L + y}{L + x} \right) t_1 = \left(\frac{250 + 230}{250 + 350} \right) \times 50 \\ = \frac{480}{600} \times 50 = 40 \text{ s}$$

EXAMPLE 23. From stations A and B, two trains start moving towards each other with the speeds of 150 km/h and 130 km/h, respectively. When the two trains meet each other, it is found that one train covers 20 km more than that of another train. Find the distance between stations A and B.

Sol. Here, $a = 150$ km/h, $b = 130$ km/h and $d = 20$ km

According to the formula,

$$\text{Distance between stations A and B} = \left(\frac{a + b}{a - b} \right) \times d \\ = \left(\frac{150 + 130}{150 - 130} \right) \times 20 = \frac{280}{20} \times 20 = 280 \text{ km}$$

EXAMPLE 24. The distance between two stations P and Q is 110km. A train with speed of 20km/h leaves station P at 7:00 am towards station Q. Another train with speed of 25 km/h leaves station Q at 8:00 am towards station P. Then, at what time both trains meet?

Sol. Here, $d = 110$ km, $t = 8 : 00 - 7 : 00 = 1$ h

$a = 20$ km/h and $b = 25$ km/h

$$\text{Time taken by trains to meet, } T = \left(\frac{d + tb}{a + b} \right)$$

$$\Rightarrow T = \frac{110 + (1)(25)}{20 + 25} = \frac{135}{45}$$

$$\Rightarrow t = 3 \text{ h}$$

\therefore They will meet at = 7 : 00 am + 3 h = 10 : 00 am.

EXAMPLE 25. The distance between two stations A and B is 138 km. A train starts from A towards B and another from B to A at the same time and they meet after 6 h. The train travelling from A to B is slower by 7 km/h compared to other train from B to A, then find the speed of the slower train?

Sol. Here, $d = 138$ km, $t = 6$ h and $x = 7$ km/h

$$\therefore \text{Speed of slower train} = \frac{d - tx}{2t} = \frac{138 - (6)(7)}{2(6)} \\ = \frac{138 - 42}{12} = \frac{96}{12} = 8 \text{ km/h}$$

EXAMPLE 26. A train covers distance between two stations A and B in 2h. If the speed of train is reduced by 6 km/h, then it travels the same distance in 3 h. Calculate the distance between two stations and speed of the train.

Sol. Here, $t_1 = 2$ h, $t_2 = 3$ h, $a = 6$ km/h and $d = ?$

(i) Distance between A and B is

$$d = a \left(\frac{t_1 t_2}{t_2 - t_1} \right) \text{ km}$$

$$\Rightarrow d = 6 \left(\frac{2 \times 3}{3 - 2} \right) \Rightarrow d = 36 \text{ km}$$

$$(ii) \text{ Speed of the train} = \frac{a t_2}{t_2 - t_1} = \frac{6 \times 3}{3 - 2} = 18 \text{ km/h}$$

EXAMPLE 27. A boat is rowed down a river 28 km in 4 hours and up a river 12 km in 6 hours. Find the speed of the boat and the river.

Sol. Downstream speed is $\frac{28}{4} = 7 \text{ kmph}$

Upstream speed is $\frac{12}{6} = 2 \text{ kmph}$

$$\begin{aligned} \text{Speed of Boat} &= \frac{1}{2} (\text{Downstream} + \text{Upstream Speed}) \\ &= \frac{1}{2} [7 + 2] = 4.5 \text{ kmph} \end{aligned}$$

$$\begin{aligned} \text{Speed of current} &= \frac{1}{2} (\text{Downstream} - \text{Upstream speed}) \\ &= \frac{1}{2} (7 - 2) = 2.5 \text{ kmph} \end{aligned}$$

EXAMPLE 28. P, Q, and R are the three towns on a river which flows uniformly. Q is equidistant from P and R. I row from P to Q and back in 10 hours and I can row from P to R in 4 hours. Compare the speed of my boat in still water with that of the river.

- (a) 4 : 3 (b) 5 : 3
(c) 6 : 5 (d) 7 : 3
(e) None of these

Sol. (c) Let the speed of the boat be v_1 and the speed of the current be v_2 and d be the distance between the cities.

$$\text{Now, } \frac{d}{v_1 + v_2} = 4 \text{ and } \frac{d}{v_1 - v_2} = 6$$

$$\Rightarrow \frac{v_1 + v_2}{v_1 - v_2} = \frac{6}{4}$$

$$\text{or } \frac{2v_1}{2v_2} = \frac{10}{2} \text{ or } \frac{v_1}{v_2} = 5 : 1$$

$$\text{Required ratio} = (5 + 1) : 5 = 6 : 5$$

EXAMPLE 29. A man can row 6 km/h in still water. When the river is running at 1.2 km/h, it takes him 1 hour to row to a place and back. How far is the place?

Sol. Man's rate downstream = $(6 + 1.2) = 7.2 \text{ km/h}$.
Man's rate upstream = $(6 - 1.2) \text{ km/h} = 4.8 \text{ km/h}$.
Let the required distance be $x \text{ km}$.

$$\text{Then } \frac{x}{7.2} + \frac{x}{4.8} = 1 \text{ or } 4.8x + 7.2x = 7.2 \times 4.8$$

$$\Rightarrow x = \frac{7.2 \times 4.8}{12} = 2.88 \text{ km}$$

SHORTCUT METHOD

$$\text{Required distance} = \frac{1 \times (6^2 - (1.2)^2)}{2 \times 6}$$

$$= \frac{36 - 1.44}{12} = \frac{34.56}{12} = 2.88 \text{ km}$$

EXAMPLE 30. Rajnish can row 12 km/h in still water. It takes him twice as long to row up as to row down the river. Find the rate of stream.

Sol. Here, speed of Rajnish in still water = 12 km/h
 $n = 2$; Speed of stream (a) = ?

According to the formula,

$$\text{Speed in still water} = \frac{a(n+1)}{(n-1)}$$

$$\Rightarrow 12 = \frac{a(2+1)}{(2-1)}$$

$$\Rightarrow 3a = 12$$

$$\therefore a = \frac{12}{3} = 4 \text{ km/h}$$

EXAMPLE 31. Vikas can row a certain distance downstream in 6 hours and return the same distance in 9 hours. If the stream flows at the rate of 3 km/h, find the speed of Vikas in still water.

Sol. By the formula,

$$\text{Vikas's speed in still water} = \frac{3(9+6)}{9-6} = 15 \text{ km/h}$$

EXAMPLE 32. Two ferries start at the same time from opposite sides of a river, travelling across the water on routes at right angles to the shores. Each boat travels at a constant speed though their speeds are different. They pass each other at a point 720m from the nearer shore. Both boats remain at their sides for 10 minutes before starting back. On the return trip they meet at 400m from the other shore. Find the width of the river.

- (a) 1760m (b) 1840m
(c) 2000m (d) Cannot be found
(e) None of these

Sol. (a)

Let the width of the river be x .

Let a, b be the speeds of the ferries.

$$\frac{720}{a} = \frac{(x - 720)}{b} \quad \dots\dots\dots (i)$$

$$\frac{(x - 720)}{a} + 10 + \frac{400}{a} = \frac{720}{b} + 10 + \frac{(x - 400)}{b} \quad \dots\dots\dots (ii)$$

(Time for ferry 1 to reach other shore + 10 minute wait + time to cover 400m)

= Time for ferry 2 to cover 720m to other shore + 10 minute wait + Time to cover $(x - 400\text{m})$

$$\text{Using (i), we get } \frac{a}{b} = \frac{720}{(x - 720)}$$

$$\text{Using (ii), } \frac{(x - 320)}{a} = \frac{(x + 320)}{b} \Rightarrow \frac{a}{b} = \frac{(x - 320)}{(x + 320)}$$

On, solving we get, $x = 1760\text{m}$

EXAMPLE 33. A man rows 27km with the stream and 15km against the stream taking 4 hours each time. Find this rate per hour in still water and the rate at which the stream flows.

Sol. Speed with the stream = $\frac{27}{4} = 6\frac{3}{4} \text{ kmph}$

$$\therefore \text{Speed against the stream} = \frac{15}{4} = 3\frac{3}{4} \text{ kmph.}$$

$$\therefore \text{Speed of the man in still water}$$

$$= \frac{1}{2} \left(6\frac{3}{4} + 3\frac{3}{4} \right) = 5\frac{1}{4} \text{ kmph}$$

$$\therefore \text{Speed of the stream} = \frac{1}{2} \left(6\frac{3}{4} - 3\frac{3}{4} \right) = 1.5 \text{ kmph}$$

EXAMPLE 34. On a river, B is between A and C and is also equidistant from A and C. A boat goes from A to B and back in 5 hours 15 minutes and from A to C and back in 7 hours. How long will it take to go from C to A if the river flows from A to C?

Sol. If the speed in still water is x kmph and speed of the river is y kmph, speed down the river $= x + y$ and speed up the river $= x - y$.

$$\therefore \frac{d}{x+y} + \frac{d}{x-y} = 5\frac{1}{4} \quad \dots\dots\dots (1)$$

$$\frac{2d}{x+y} = 7 \quad \dots\dots\dots (2)$$

$$\text{Multiplying (1) by 2, we get } \frac{2d}{x+y} + \frac{2d}{x-y} = 10\frac{1}{2}$$

$$\Rightarrow 7 + \frac{2d}{x-y} = \frac{21}{2} \quad \left[\because \frac{2d}{x-y} = 7 \right]$$

$$\Rightarrow \frac{2d}{x-y} = 3\frac{1}{2} \text{ hours} = \text{Time taken to travel from C to A.}$$

EXAMPLE 35. Ramesh rows in still water with speed of 4.5 km/h to go to a certain place and to come back. Find his average speed for the whole journey, if the river is flowing with a speed of 1.5 km/h.

Sol. Here, $a = 4.5$ km/h, $b = 1.5$ km/h

$$\text{Average speed} = \frac{(a+b)(a-b)}{a}$$

$$= \frac{(4.5+1.5)(4.5-1.5)}{4.5} = \frac{6 \times 3}{4.5} = \frac{18}{4.5} = 4 \text{ km/h}$$

EXAMPLE 36. A person goes from Delhi to Agra at a speed of 60 km/h by car and return to Delhi by train at a speed of 50 km/hr. Find the average speed during the whole journey.

$$\text{Sol. Average speed} = \frac{2ab}{a+b} = \frac{2 \times 60 \times 50}{60+50} \text{ km/hr}$$

$$= 54\frac{6}{11} \text{ km/hr}$$

EXAMPLE 37. A person goes from his village to home time in 2 hours at a speed of 20 km/hr and then from his home town he goes to his nearest railway station 1 hr 30 minutes at a speed of 30 km/hr. Find the average speed of the person in whole journey.

$$\text{Sol. Average speed} = \frac{v_1 t_1 + v_2 t_2}{t_1 + t_2}$$

$$= \frac{20 \times 2 + 30 \times \frac{3}{2}}{2 + \frac{3}{2}} = \frac{85 \times 2}{7} \text{ km/hr}$$

$$= 24\frac{2}{7} \text{ km/hr}$$

EXAMPLE 38. A policeman sees a thief at a distance of 200 m. He starts chasing the thief who is running at a speed of 10 m/sec and policeman is chasing the thief with a speed of 12 m/sec. Find the distance covered by the thief when he is caught by the policeman.

$$\text{Sol. Required distance} = d \left(\frac{a}{b-a} \right)$$

$$= 200 \left(\frac{10}{12-10} \right) \text{ m}$$

$$= 1000 \text{ m} = 1 \text{ km}$$

EXAMPLE 39. A passenger train start at 8 : 00 a.m. from station A and goes to station B. A super fast train also start at 8 : 00 a.m. from station B and goes to station A. After crossing each other, passenger train reached to station B in 16 hours and super fast train reached station A in 4 hours. Find the speed of super fast train if speed of passenger train is 30 km/hr.

Sol. (speed of passenger train) : (speed of super fast train) =

$$\sqrt{4} : \sqrt{16}$$

$$\Rightarrow 30 : (\text{speed of super fast train}) = 2 : 4$$

$$\Rightarrow \text{speed of super fast train} = 60 \text{ km/hr}$$

EXAMPLE 40. A man rows a boat from P to Q downstream in 3 hours and returns the same distance in 5 hours. If the stream flows at the rate of 5 km/hr, then find the speed of the boat in still water.

$$\text{Sol. Required speed} = \frac{Z(X+Y)}{Y-X}$$

$$= \frac{5(3+5)}{5-3} \text{ km/hr}$$

$$= 20 \text{ km/hr}$$

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